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Microwave Heating Demonstrator (MHD) payload – for fabricating construction components and extracting resources

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Introduction

Lunar regolith could be thermally treated to extract resources and build an outer habitat shell using additive manufacturing techniques (a.k.a. 3D printing) by robots [1]. Proof of concept experiments has demonstrated that microwaves couple efficiently with lunar regolith and sinter/melt it to build 3D structures and enable resource extraction [2]. However, there are still several questions that can only be answered through experiments on the Moon surface. Thus, the Open University (OU) initiated a collaborative project MARVEL (**M**icrowave heating **A**pparatus for **R**egolith **V**ariant **E**xperiments for **L**unar **I**SRU), with Added Value Solutions UK Ltd. and VIPER RF. The team aims to prepare the groundwork for the UK to lead the development of a Microwave Heating Demonstrator (**MHD**) payload on future missions to the Moon with the flight hardware being developed and built in the UK. The initial concept development of the MHD payload was completed with support from UKSA's NSTP GEI funding (Figure 1 [3]).

In this presentation, we will report the current progress of the MHD development conducted through the NSTP Pathfinder grant, focusing on the challenges with cavity design and the concept of a 1 kW solid-state microwave generator that could be used for future lunar missions.

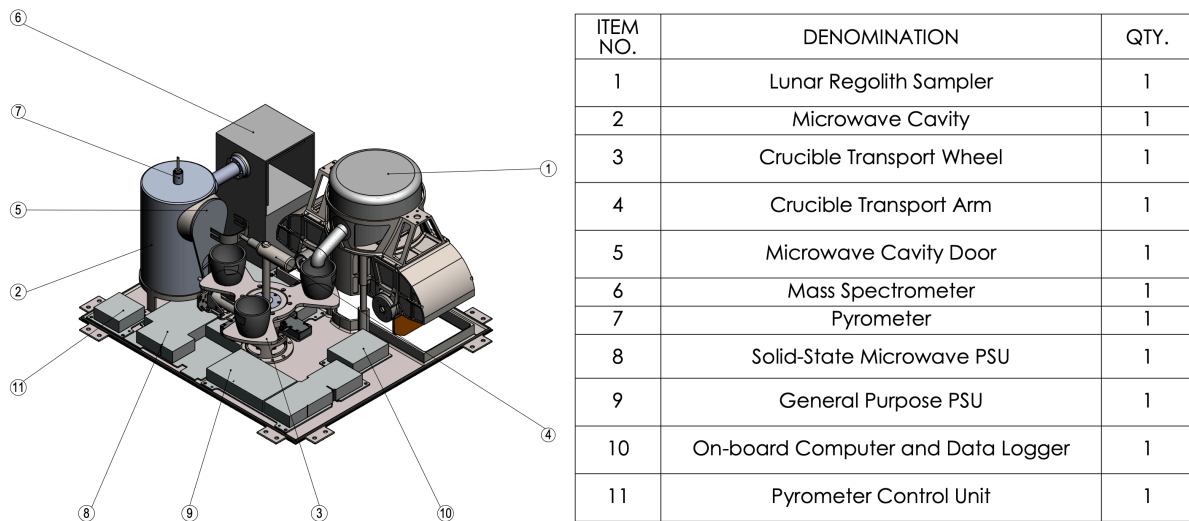


Figure 1: 3D CAD model of the MHD payload (dimensions 400 x 400 x 250 mm) [3]

References

- [1] Lim, S. et al., Extra-terrestrial construction processes - advancements, opportunities and challenges (2017), *Advances in Space Research Journal*, Vol 60, Issue 7, pp. 1413-1429.
- [2] Lim, S. et al., Investigating the potential of Building Habitats on the Moon using microwave heating of lunar simulant JSC-1A at different powers (2021), *Nature Scientific Reports*, Vol 11, Issue 1, article no: 2133.
- [3] Lim, S. et al., A microwave heating demonstrator (MHD) payload concept for lunar construction and volatile extraction (2020), *European Lunar Symposium (ELS2020)*, Padua, Italy, 12-14 May.